

MUDDY FORK COWLITZ RIVER BRIDGE

(Box Canyon Bridge)

Mount Rainier National Park

Spanning Muddy Fork Cowlitz River on Stevens Canyon Highway

Packwood Vicinity

Lewis County

Washington

HAER No. WA-60

HAER
WASH
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

U.S. Department of the Interior

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I. INTRODUCTION

Location: Spanning Muddy Fork of the Cowlitz River at Box Canyon, Stevens Canyon Highway, Mount Rainier National Park, Lewis County, Washington.
Quad: Mount Rainier East, Wash.
UTM: 10/604280/5179825

Date of Construction: 1950-52

Structure type: Stone-faced reinforced concrete filled spandrel arch bridge

FHWA Structure No.: n/a

Designer: Bureau of Public Roads, U.S. Department of Commerce

Contractor: Hawkins and Armstrong, Seattle, Washington

Owner: Mount Rainier National Park, National Park Service

Use: Park highway bridge

Significance: The "rustic style" of architecture survived into the 1950s when the Muddy Fork Cowlitz River and Nickel Creek bridges on the Stevens Canyon Highway were constructed as stone-faced reinforced concrete spandrel arch structures, echoing designs employed by the National Park Service as early as 1920. The Muddy Fork Bridge, built over the deep Box Canyon of the Cowlitz, relates especially well to the site; the gently arched bridge seems to spring naturally from the rock cliffs. The nearby tunnel [HAER No. WA-70] is a plain bore through a mountain spur; unlike other tunnels in the park, it has no masonry portals at the ends. The entire site was planned to offer access to the marvelous landscape of this site, with the deep box canyon, stretches of glacial-polished granite, and delicate subalpine plants. Site amenities include a parking area, comfort station and drinking fountains, paved pedestrian paths, an interpretive display, and a timber footbridge over the canyon. The Box Canyon site also serves as a trailhead for the round-the-mountain Wonderland Trail.

Project Information: Documentation of the Muddy Fork Cowlitz River Bridge is part of the Mount Rainier National Park Roads and Bridges Recording Project, conducted in summer 1992 by the Historic American Engineering Record.

Richard H. Quin, Historian, 1993

II. HISTORY

This is one in a series of reports prepared for the Mount Rainier National Park Roads and Bridges Recording Project. HAER No. WA-35, MOUNT RAINIER NATIONAL PARK ROADS AND BRIDGES, contains an overview history of the park roads. In addition, HAER No. WA-123, STEVENS CANYON HIGHWAY, contains more specific information on the road on which the structure is located.

Stevens Canyon Highway

The 21.2-mile Stevens Canyon Highway departs from the Nisqually Road [HAER No. WA-35a] above Narada Falls, climbs to a saddle at Reflection Lakes, then drops into the Stevens Creek Canyon. The road then traverses the cliffs on the north side of the canyon down as far as the Box Canyon of the Cowlitz River. From there, the road heads generally southeast around Backbone Ridge to a junction with the East Side Road [Washington Highway 123, HAER No. WA-124]. Although the road was not completed until 1957, even much of the later work was done in the "Rustic Style," including bridges at Box Canyon, Nickel Creek [HAER No. WA-59] and Stevens Creek [HAER No. WA-58], a fine stone culvert at Sunbeam Creek, two short tunnels and masonry retaining and parapet walls. The later work includes a series of reinforced concrete viaducts [HAER No. WA-71] which carry the road around steep sections of cliffs in Stevens Canyon and on the sides of Backbone Ridge, alleviating much scarring.

Muddy Fork Cowlitz River Bridge

The Box Canyon of the Cowlitz River is one of the most fascinating natural features of Mount Rainier National Park. The Muddy Fork of the Cowlitz River cuts a deep narrow canyon through the granite base of Stevens Ridge. This is a very narrow gorge; the river channel, only about 6' wide at this point, is a full 185' below the highway bridge above. The canyon and the adjacent glacier-swept terrain are made accessible from the Stevens Canyon Highway in a site development consisting of the Muddy Fork Cowlitz River Bridge, the adjacent Muddy Fork Tunnel [HAER No. WA-70], a parking area, a series of pedestrian footpaths, an overlook bridge, a scenic vista, comfort station and interpretive exhibit.

Prior to the construction of the Stevens Canyon Highway, the Box Canyon had been one of the attractions of the famed Wonderland Trail encircling Mount Rainier. Old photographs in the park archives show that a rustic log bridge once spanned the chasm at this site; this structure was evidently located on the site of the present timber foot bridge on the observation trail.

Construction of the Stevens Canyon Highway began in 1931, but work in the lower Stevens Canyon was delayed when World War II forced a halt to operations. While the highway work was halted, the Public Roads Administration (Depression-era successor to the Bureau of Public Roads) began preparation of designs for the structures at the site. Plans and specifications for the Muddy Fork Cowlitz River Bridge were prepared at the PRA's San Francisco regional office in May 1942.¹

The National Park Service's Branch of Plans and Design, also headquartered in San Francisco, prepared the architectural sheets for the bridge in October 1942. These drawings specified details for the construction of the arch ring, placement of the granite masonry veneer, and the relationship of the bridge to the site.² The cooperation between the Public Roads Administration and the Branch of Plans and Design was a long relationship, first established between the two agencies' predecessors, the Bureau of Public Roads and the NPS Division of Landscape Engineering. Under this arrangement, the BPR/PRA was

responsible for design, engineering and construction supervision, while the NPS oversaw landscape details and retained design control and approval for all joint projects.

The Public Roads Administration attempted to resume work on the Stevens Canyon Highway in 1947 by advertising for bids for the construction of the Box Canyon and Nickel Creek bridges. However, no bids were received, and the PRA was forced to suspend its plans.³ Projects were advertised again in the fall of 1949, and this time awards were made for the remaining work in the Box Canyon-Nickel Creek area. The bids were opened at the District 8 Office of the Bureau of Public Roads in Portland, Oregon, on 29 November 1949.⁴ The contracts were awarded on 3 February 1950 to Hawkins and Armstrong of Seattle (for the two bridges and a viaduct at Backbone Ridge) and to J. H. and W. J. Conley of Portland, Oregon (for the Box Canyon Tunnel). By the end of the year, grading work was 97 percent complete. However, the two bridges were just underway, guard rails had not been constructed, some slope stabilization remained, and the road had not been surfaced. Engineers from the reconstituted Bureau of Public Roads estimated that the road work would require another three years.⁵

Construction of the Muddy Fork Bridge began in the late spring of 1950. On 29 May, contractors Hawkins and Armstrong moved into a camp at Nickel Creek and prepared to begin work at Box Canyon.⁶ The contractors began drilling face stone for the bridge at a quarry on the Stevens Canyon Highway right of way at Station 434. By 10 June, it became apparent that good masonry stones could not be obtained from this source. On 23 June, the contractors were given permission to take stone from a rock cropping at Station 601. A change order provided the contractors with payment for additional transportation, loading and unloading, and moving of equipment and facilities necessitated by the change of stone quarries.⁷ [Erwin N. Thompson's 1978 *Historic Resource Study* for Mount Rainier National Park suggests that the stone facing for the bridge was taken from the adjacent tunnel bore.⁸ While some stone from that excavation may have been used, the BPR report seems to indicate that the stone was acquired from the cut on the right-of-way. The Box Canyon Tunnel is located at Stations 428 and 429; Station 434 is the location of the main Box Canyon parking area.]

Unfortunately, the Bureau of Public Roads' final construction report for the project does not include many specific details of the construction work. However, original photographs filed with the report are dated and provide some good information on operations. The timber trusses for the arch ring falsework were in place by 13 September 1950. There were five of these trusses arranged in parallel. A photo dated 26 October shows the large arch ring stones or voussoirs in place on the falsework; the caption draws attention to the "saw tooth" effect achieved through the trim of the individual voussoirs. A second photo taken that day from another angle shows the arch slab reinforcing steel in place and concrete being poured.⁹

The construction drawings provide some information on the steel reinforcing. Unlike the common barrel arches employed on many of the earlier park bridges, the Muddy Fork Bridge was constructed on reinforced concrete cross side girders. This arrangement allowed construction in sections; the girders were prefabricated and hoisted into place with cranes because the deep canyon did not allow footings for traditional falsework.) Main reinforcing bars for the arch extended over the tie beams or cross girders were 1" diameter bars on 9" centers. Lateral bars were ½" diameter bars on 2' centers. For the spandrel walls, horizontal bars were 1/2" diameter bars on 1' centers, joined by ½" tie bars on 2' centers. The masonry facing averaged 1' 10" thick.¹⁰

Work on the bridge progressed steadily until winter conditions forced a seasonal shutdown on 10 November 1950. By this point, the stone voussoirs had been erected and the arch slab had been poured. Some of the stone facing had been cut from patterns.¹¹

Work at the site resumed on 8 May 1951 and continued until 22 October, when winter again forced a suspension of operations. By the end of August the structure was complete except for the two wing walls on the west side and the placing of fill.¹² At winter shutdown, the concrete work was finished, the masonry walls were 60 percent complete and parapet walls 45 percent complete. The other stone facing work was complete and more than half of the spandrel fill had been applied.¹³

The 1952 season began on 8 July. The Muddy Fork Bridge was in condition for travel by construction vehicles on 9 August 1952, and the contractors, Hawkins and Armstrong, finished their contract work on the structure three weeks later. They turned their full attention to completion of the Nickel Creek Bridge. A photo taken at Box Canyon on 6 October shows the masonry work largely complete. Another photo taken seventeen days later shows the masonry retaining walls extending east from the bridge as complete.¹⁴ (These join the boundary walls for the adjacent parking area). The contractors closed their construction camp and completed the final cleanup work by 23 October.¹⁵ Stone curbs for the sidewalks were later placed, and bituminous asphalt sidewalks and 8" base and a bituminous surfacing were applied to the bridge under a subsequent contract.¹⁶

On 30 October 1952, Sanford Hill, Assistant Director for the National Park Service's Region Four office in San Francisco, wrote BPR Division 8 Engineer W. H. Lynch, recommending acceptance of the bridges and viaducts. He noted that the project had been inspected on 17 September and some work remained to be done on the Muddy Fork Bridge, including the final placing of spandrel fill. However, Mount Rainier National Park Superintendent Preston P. Macy had inspected the project on 23 October and found all the work had been completed.¹⁷

In August 1953, landscape architects for the National Park Service's Western Regional Office in San Francisco prepared designs for a scenic vista and interpretive exhibit at the Box Canyon site. The exhibit was to be located on an outcropping of the glacier-swept granite. The adjacent viewpoint was to be constructed on the edge of the cliffs as an "asphalt circle" bounded by railing. The area was to be bounded by 200' of metal railing, and 250' of "worm-rail" fencing was to be used to border the trails. North of the interpretive area, a second trail would lead to a comfort station. A drinking fountain was to be provided at the edge of the parking area.¹⁸ Evidently, these plans were approved, as the interpretive area was subsequently constructed according to the drawings. The "worm-rail" or split-rail fences have been extended, and replaced the earlier-specified metal railings.

The Stevens Canyon Highway was finally opened to public travel on 4 September 1957. A ribbon-cutting ceremony to mark the occasion was held at Box Canyon.¹⁹ The parking area for the Box Canyon Picnic Area, just west of the tunnel, was constructed in the summer and early fall of 1958 by the Pieler Construction Company of Seattle at a cost of \$22,332.74. This area opened in 1961.²⁰

The bridge was resurfaced in 1966 by the Cascade Asphalt Paving Company of Tacoma, Washington, as part of a general resurfacing contract for nearly twelve miles of the Stevens Canyon Highway and the East Side Road. As part of

this work, the traffic island in the parking lot at the bridge was reconstructed, and the trail on the west side of Box Canyon was paved.²¹

DESCRIPTION

Muddy Fork Cowlitz River Bridge

The Stevens Canyon Highway spans the deep Box Canyon of the Cowlitz on a stone-faced reinforced concrete spandrel arch bridge built along the same general lines as earlier "rustic style" bridges constructed in Mount Rainier National Park. The 160' bridge spans the chasm on a single semi-elliptical arch with a clear span 79'. This arch is constructed from prefabricated reinforced concrete side girders joined by concrete tie beams. The arch rises 18' 3 1/2" from the spring line, but the river bed is another 160' or so below. The bridge's 40' 8" width carries two roadway lanes, each about 14' wide. (These are described on the construction drawings as 13' and 15' wide respectively, but were lined to the same width at the time of the recording project). The deck also features bituminous concrete sidewalks on both sides and masonry parapet walls.

The bridge is built on a very gentle parabolic curve of 6° radius, and is superelevated from the upstream (north) to the downstream side at .07' per foot of roadway (this is roughly a 5 percent slope). The roadway and sidewalks are surfaced on an almost imperceptible 0.72 percent grade rising from the east end to the west. The bridge rests on concrete stub foundations resting directly on the granite bedrock of the canyon cliffs. The stone-faced concrete spandrel and wing walls extend to either side of the central arch. Stepped expansion joints, packed with a half-inch of joint filler, separate the spandrel and wing walls. Two more joints are located over the haunches of the arch.

Broken range masonry spandrel walls, wing walls, and parapet are characteristic of the "rustic style," which aimed to harmonize structures with their natural surroundings. The irregular granite veneer used on the bridge integrates with the polished granite terrain at the site. The graceful arch structure relates very well to the site; a metal truss or concrete girder bridge would have proved intrusive. As it is, the bridge not only carries the traffic traveling over the Stevens Canyon Highway, but also serves as a very popular pedestrian overlook, and thousands of visitors take advantage of its stunning view into the deep dark canyon.

Muddy Fork [Box Canyon] Tunnel

See the related report in this series, HAER No. WA-70.

Box Canyon Development

The Muddy Fork Cowlitz River Bridge and the tunnel are two elements of a larger development providing access to the unique site. In August 1941, while it was preparing architectural plans for the Muddy Fork Bridge, the National Park Service's Branch of Plans and Design designed a 33-car parking area to be located east of the bridge on the south side of the Stevens Canyon Highway. The parking area was to be bounded by a stone retaining wall joined to the south wing wall of the bridge and would be separated from the highway by a landscaped traffic island bounded by a stone curb. The parking area was constructed under the Hawkins and Armstrong contract and was completed in 1952.

Two short trails lead south from the parking area to a comfort station and to an interpretive exhibit and scenic overlook. The comfort station is a small rectangular frame structure with a low gabled roof. The interpretive display is a small "rustic style" structure with a shingled gable roof supported by log braces. A mounted exhibit explains the effects of glacial action on the surrounding bedrock ("like a giant rasp," according to the panel). The nearby observation area is a circular viewpoint bordered by the split rail fence. It offers spectacular views of Mount Rainier (14,411.1'), fourteen miles distant, and Mount Adams (12,276'), forty miles to the south. These developments were constructed between 1953 and 1957. Two drinking fountains and a new (1992) recycling station and display are located at the edge of the parking area.

Across the road, a paved trail provides a connection with the famed Wonderland Trail encircling Mount Rainier. The access trail meets the Wonderland Trail about 300' north of the bridge. From this junction, the Wonderland Trail proceeds east and then north to the Nickel Creek and Indian Bar areas; heading in the other direction, it follows the Box Canyon upstream another four hundred feet before swinging north to cross the gorge on the timber observation footbridge. This is a simple stringer structure with a plank deck and sawn board guard rails backed by wire fencing. Across the bridge, the Wonderland Trail turns south and then southwest, climbing a short slope to cross above the Box Canyon Tunnel before dropping into Stevens Canyon and continuing on to Paradise and Longmire. A short spur trail from the base of the initial climbs takes day-hikers back to the west side of the Muddy Fork Bridge.

III. ENDNOTES

1. U.S. Department of Commerce, Bureau of Public Roads, "Muddy Fork River Bridge, Stevens Canyon Highway, Sta. 432, Rainier Nat'l. Park Route 4-D," construction drawings RG 761 A-C, 3 sheets (San Francisco, CA: Bureau of Public Roads, Western Headquarters, May 1942). [Note: drawings are labeled "Bureau of Public Roads," but again, at this point the agency had been reorganized as the Public Roads Administration.]
2. U.S. Department of the Interior, National Park Service, Branch of Plans and Design, "Architectural Plans, Muddy Fork Bridge, Station 432+0B.5, Route 4-D, Stevens Canyon Highway, Mount Rainier National Park," construction drawings PG 761 A-E, 5 sheets (San Francisco, CA: National Park Service, Branch of Plans and Design, 3 October 1942).
3. John C. Preston, Superintendent, Mount Rainier National Park, Superintendent's Annual Report, 1947, 7. MORA Archives, Box H2621, Superintendents' Annual Reports 1941-1953 file.
4. W. H. Lynch, Division Engineer, Bureau of Public Roads, Portland, OR, to Preston, 10 November 1949. MORA Archives, Roads and Trails Box 1.
5. Preston, Superintendent's Annual Report, 1950, 7. MORA Archives, Box H2621, Superintendents' Annual Reports 1941-1953 file.
6. N. L. James, Resident Engineer, U.S. Department of Commerce, Bureau of Public Roads, "Final Construction Report, Stevens Canyon Highway, Mt. Rainier National Park Project 4-D and 4-E2, Units 1 and 3, Bridges and Viaducts, Mt. Rainier National Park, Lewis County, Washington" (Portland, OR: Bureau of Public Roads, 1954), 2; Preston, Superintendent's Monthly Report, May 1950, 3. MORA Archives, Box H2621, Superintendents' Monthly Reports 1947-1952 file.
7. James, 2.
8. Erwin N. Thompson, *Mount Rainier National Park, Washington: Historic Resource Study* (Denver, CO: National Park Service, Denver Service Center, 1978), 227.
9. Bureau of Public Roads photographs #52045, 13 September 1950; #52054, 26 October 1950; #52051, 26 October 1950, filed in James, *op cit.*
10. See BPR construction drawing RG 761-B.
11. James, 2.
12. Preston P. Macy, Superintendent, Mount Rainier National Park, Superintendent's Monthly Report, August 1951, 3. MORA Archives, Box H2621, Superintendents' Monthly Reports 1947-1952 file.

13. *Ibid.*.

14. BPR construction photos #52666, 6 October 1952; #52628, 23 October 1952, in James, *op cit.*

15. James, 2-3; Curtis K. Skinner, Acting Superintendent, Mount Rainier National Park, Superintendent's Monthly Report, August 1952, 4; Macy, Superintendent's Monthly Report, September 1952, 3. MORA Archives, Box H2621, Superintendents' Monthly Reports 1947-1952 file.

16. James, 2.

17. Sanford Hill, Assistant Regional Director, National Park Service Region Four, San Francisco, CA, to W. H. Lynch, Division Engineer, Bureau of Public Roads, Division 8, Portland, OR, 30 October 1952, attached to James, *op cit.*

18. U.S. Department of the Interior, National Park Service, Landscape Division, Western Regional Office, "Muddy Fork Viewpoint, Stevens Canyon Highway," construction drawing NP RAI 305-C (San Francisco, CA: National Park Service, Western Regional Office, 23 August 1953).

19. Macy, Superintendent's Annual Report, 1958, 4. MORA Archives, Box H2621, Superintendents' Annual Reports 1954-1966 file.

20. Earl B. Wilson, Park Engineer, Mount Rainier National Park, "Completion Report R-159, Box Canyon Picnic Area Roads," typed MSS, 20 November 1959, 1. MORA Archives, Roads and Trails Box 1; Ruben O. Hart, Acting Superintendent, Mount Rainier National Park, Superintendent's Annual Report, 1962, 2. MORA Archives, Box H2621, Superintendents' Annual Reports 1962-1964 file.

21. J. P. McGarry, Resident Engineer, Bureau of Public Roads, "Final Construction Report, Stevens Canyon Road and East Side Road, Mt. Rainier National Park Project C-14, D10, E14 & 5-A6, Bituminous Surfacing and Roadside Improvement, Mt. Rainier National Park, Lewis County, Washington" (Portland, OR: Bureau of Public Roads, 1969), 1.

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U.S. Department of the Interior, National Park Service, Landscape Division, Western Regional Office. "Muddy Fork Viewpoint, Stevens Canyon Highway." Construction drawing NP RAI 305-C. San Francisco, CA: National Park Service, Western Regional Office, 23 August 1953.

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ADDENDUM TO

MUDDY FORK COWLITZ RIVER BRIDGE

(Box Canyon Bridge) Mount Rainier National Park Roads & Bridges
Spanning Muddy Fork Cowlitz River on Stevens Canyon Highway
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